

WHAT IS CLAIMED IS:

1. A lithographic apparatus comprising:
an illumination system that provides a beam of radiation,
a support structure that supports a patterning device, said patterning device capable of a desired pattern onto said beam of radiation,
a substrate holder that holds a substrate,
a projection system that projects the patterned beam onto said substrate; and
an actuator that produces a force between a first apparatus part and a second part to displace said first and second apparatus parts relative to each, wherein said first apparatus part comprises at least a part of one of said illumination system, said support structure, said substrate holder, and said projection system and said second apparatus part comprises at least another part of one of said illumination system, said support structure, said substrate holder, and said projection system, said actuator comprising:

a first magnet system subassembly and a second magnet system subassembly that comprise a main magnet system configured to provide a first magnetic field and a subsidiary magnet system configured to provide a second magnetic field, said main and subsidiary magnet systems attached to said first apparatus part;

an electrically conductive element configured to produce said force based on an interaction between an electric current carried by said electrically conductive element and said first and second magnetic fields, said electrically conductive element attached to said second apparatus part and interposed between said first and second magnet system subassemblies; and

a magnetic element extending substantially between outer portions of said first and second magnet system subassemblies, said magnetic element configured to guide a portion of said second magnetic field from one of said first and second magnet system subassemblies to the other one of said first and second magnet system subassemblies.

2. The lithographic apparatus of Claim 1, wherein said main magnet system and said subsidiary magnet system are arranged in a Halbach configuration.

3. The lithographic apparatus of Claim 1, wherein said magnetic element comprises a highly magnetically permeable material.

4. The lithographic apparatus of Claim 1, wherein said magnetic element extends between mutually opposing subsidiary magnets comprised in said subsidiary magnet system, wherein said mutually opposing subsidiary magnets have substantially anti-parallel polarizations.

5. The lithographic apparatus of Claim 4, wherein said magnetic element extends between sides of said mutually opposing subsidiary magnets relative to adjacent main magnets of said main magnet system.

6. The lithographic apparatus of Claim 1, wherein said magnetic element comprises a permanent magnet having a polarity in a direction from one of said first and second magnet system subassemblies to the other one of said first and second magnet system subassemblies.

7. The lithographic apparatus of Claim 6, wherein said magnetic element extends between parts comprising a highly magnetically permeable material located adjacent to main magnets of said first and second magnet system subassemblies.

8. The lithographic apparatus of Claim 1, wherein a distance between said conductive element and said magnetic element is sufficiently large to cause a reluctance force of said actuator to be less than 1% of a maximum force produce by said actuator.

9. An actuator for producing a force between a first and a second part to displace one of said first and second parts relative to the other of said first and second parts, said actuator comprising:

a first actuator subassembly comprising a first magnet system subassembly and a second magnet system subassembly, said first and second magnet system subassemblies comprising a main magnet system configured to provide a first magnetic field and a subsidiary magnet system configured to provide a second magnetic field, said main and subsidiary magnet systems attached to said first part;

a second actuator subassembly comprising an electrically conductive element configured to produce said force based on an interaction between an electric current carried by said electrically conductive element and said first and second magnetic fields, said electrically conductive element attached to said second part and interposed between said first and second magnet system subassemblies; and

a magnetic element extending substantially between outer portions of said first and second magnet system subassemblies, said magnetic element configured to guide a portion of said second magnetic field from one of said first and second magnet system subassemblies to the other one of said first and second magnet system subassemblies.

10. The actuator of Claim 9, said main magnet system and said subsidiary magnet system being arranged in a Halbach configuration.

11. The actuator of Claim 9, wherein said magnetic element comprises a highly magnetically permeable material.

12. The actuator of Claim 9, wherein said magnetic element extends between mutually opposing subsidiary magnets comprised in said subsidiary magnet system, wherein said mutually opposing subsidiary magnets have substantially anti-parallel polarizations.

13. The actuator of Claim 12, wherein said magnetic element extends between sides of said mutually opposing subsidiary magnets relative to adjacent main magnets of said main magnet system.

14. The actuator of Claim 9, wherein said magnetic element comprises a permanent magnet having a polarity in a direction from one of said first and second magnet system subassemblies to the other one of said first and second magnet system subassemblies.

15. The actuator of Claim 14, wherein said magnetic element extends between parts comprising a highly magnetically permeable material located adjacent to main magnets of said first and second magnet system subassemblies.

16. The actuator of Claim 9, wherein a distance between said conductive element and said magnetic element is sufficiently large to cause a reluctance force of said actuator to be less than 1% of a maximum force produce by said actuator.

17. A device manufacturing method comprising:
providing a substrate held by a substrate holder;
providing a beam of radiation using an illumination system;
imparting a desired pattern onto said beam of radiation by a patterning device supported by a support structure;
projecting said patterned beam of radiation onto a target portion of said substrate via a projection system;

producing a force to displace a first apparatus part and a second apparatus part relative to each other, wherein said first apparatus part comprises at least a part of one of said illumination system, said support structure, said substrate holder, and said projection system and said second apparatus part comprises at least another portion of one of said illumination system, said support structure, said substrate holder, said force producing comprises:

generating a first magnetic field from a main magnet system of a first magnet system subassembly and a second magnet system subassembly, said main magnet system being attached to said first part;

generating a second magnetic field from a subsidiary magnet system of said first and second magnet system subassemblies, said subsidiary magnet system being attached to said first part;

producing said force based on an interaction between an electric current carried by an electrically conductive element and said first and second magnetic fields, said electrically conductive element being attached to said second part; and

guiding a portion of said second magnetic field from one of said first and a second magnet system subassemblies to the other of said first and second magnet system subassemblies.

18. The device manufacturing method of Claim 17, wherein the first magnetic field and the second magnetic field are arranged in a Halbach configuration.